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GAS IN INDUSTRY

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Vol. 2 No. 9

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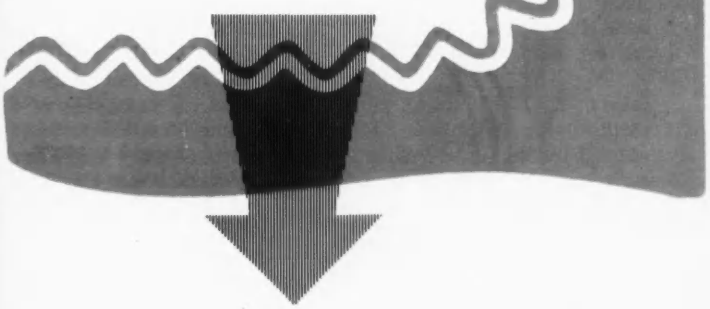

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GAS IN INDUSTRY

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FEATURES

ADVANTAGES OF AN ECONOMICAL MELTING UNIT

CONTROLLED ATMOSPHERES DERIVED FROM TOWN GAS FOR THE HEAT TREATMENT OF METALS

PRESSED STEEL COMPANY CHOOSES GAS FOR CANTEEN AT NEW SWINDON WORKS

MEASUREMENT OF GAS STREAM TEMPERATURES IN INDUSTRIAL APPLIANCES—
P. G. Atkinson and J. R. Hargreaves

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Editorial

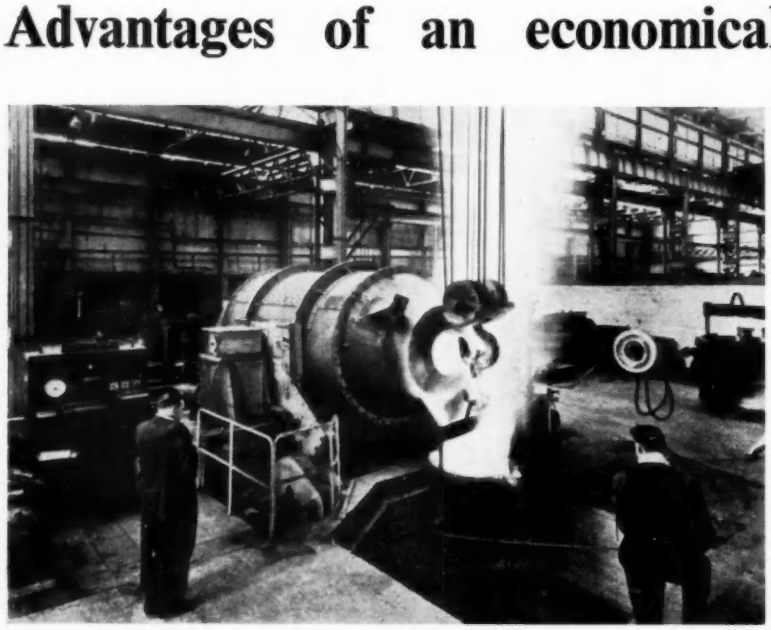
Controlled Atmospheres

AN advantage enjoyed by gas when employed as a fuel in industry is its additional use to control the composition of the 'atmosphere' in the furnace itself. The composition of this atmosphere is of the utmost importance when metals are undergoing heat treatment prior to tempering or hardening to prevent the formation of scale, the discolouring of the metal, and even a change in the composition of the metallic surface itself. In fact, by carefully introducing special gaseous substances into the furnace atmosphere, metals may be case hardened to the depth required. The gas-heated furnace, therefore, not only allows tightly controlled temperature conditions but also makes certain that the metals being treated will emerge undamaged without the need for further process work being done on them in the form of de-scaling or subsequent repolishing. This control and the flexibility of the gas-fired furnace make possible the incorporation of the gas-heated unit as part of a continuous process, which would be very much more difficult if solid fuel were employed. Where an electric furnace is used in place of gas, it would be necessary to provide additional plant for the production of the suitable atmosphere.

These and other points are brought out in an article which we publish this month and in which are discussed the possibilities of furnace atmosphere control by town gas. Gas-fired furnace design may be simplified by dispensing with the need of a muffle and substituting direct heating, but care must be exercised to ensure that the composition of the atmosphere is maintained within fine limits. To do this, external generators are used in which town gas is burnt under strictly controlled conditions to provide flue gases of the required composition for introduction into the furnace. These flue gases fall into two main categories, exothermic and endothermic, according to the combustion conditions under which they are generated. Their composition is different in each case and so each has its special application. In certain cases these gases need further treatment, such as the extraction of the carbon dioxide and sulphur contained in them.

In the formation of gaseous atmospheres, the need for a constant composition of the town gas used is essential; so also is the lowest possible sulphur content, since the presence of this element may be injurious to the metals being treated. Of this the gas industry is fully aware. The new gas-making processes now being developed should go far to produce large volumes of constant quality gas of very low sulphur content, which should make town gas eminently suitable for this and other industrial purposes. An alternative source of gas for the production of furnace atmospheres is from the liquefied petroleum gases being produced in quantity and available in a high state of purity. Their use, however, makes necessary the installation of storage vessels, the strictest possible safety measures and the need for delivery in road tanker wagons. The extra expense involved and the possible interruption in delivery therefore outweighs such advantages as might appear at first sight. The statutory obligation of the gas boards to supply gas at suitable pressure and quality assures a constant gas supply at all times.

Advantages of an economical melting unit



One of a battery of tilting rotary furnaces.

COMPARISON BETWEEN STANDARD ROTARY MELTING FURNACE AND TILTING TYPE

OWING to a certain similarity in name as well as in general appearance, there is occasionally a little confusion between a standard rotary melting furnace and a tilting rotary, and as it is announced that the well-known makers of the former type, the Monometer Manufacturing Co., Ltd., of Savoy House, London, W.C.2, have recently acquired the manufacturing rights of the Stein & Atkinson tilting rotary, it is possible to examine the features of both types without invidiousness.

In the first place, both types by reason of their large capacity are expressly designed for bulk melting, and from the point of view of construction and automatic equipment either type is to be regarded more in the light of a molten-metal production machine rather than the somewhat crude and simple type of apparatus which is usually visualised by the term melting furnace.

Low consumption

In essentials, a standard rotary furnace, as will be seen from Fig. 1, is a cylindrical shell lined with refractory, fired by a burner at one end, rotated on rollers during the melting period, and tapped from a spout which may be situated in the middle or, when required, mounted on the conical end of the furnace body.

The rotation of the furnace during mixing and melting is one of the reasons for its extremely low consumption figures, as not only is the metal brought down by flame radiation over and through the charge but also by contact with the heated refractory lining of the furnace as this revolves. The rotary action also serves to prolong the life of the lining, as during the rotation the lining is cooled by contact with the charge and this useful heat absorbed by the latter so overheating of the lining does not occur. The construction, as will be seen, is such that it is easy to arrange for the products of combustion to be discharged into an efficient form of recuperator, this being particularly necessary when melting irons or steels. Rotation is normally effected by automatic mechanical means.

The tilting rotary type, in principle, also consists of a somewhat similar cylindrical shell rotating on rollers during the progress of a melt, and it can likewise readily be arranged for the products of combustion to be passed into a recuperator. In this case, however, the cylindrical shell with the rollers and rotating gear are carried in a cradle with a quadrant gear, this cradle being supported at each side in the manner shown by the sectional view Fig. 2, giving a type of construction which allows for tilting the furnace axially to any convenient angle as shown by the diagrams. At 'a' the furnace is shown in its melting position; 'b' shows the position for charging either from an overhead platform, hopper and chute, or a mechanical charging truck; 'c' is the slagging position; 'd' is the normal pouring position, although it can be effected from the other end if required.

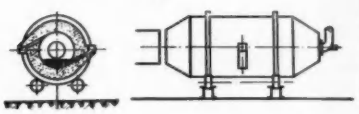


Fig. 1. Diagram showing standard rotary furnace.

Small movement

The pouring spouts are normally fitted at the conical ends, and in this connection the very small movement of the spout between the start and

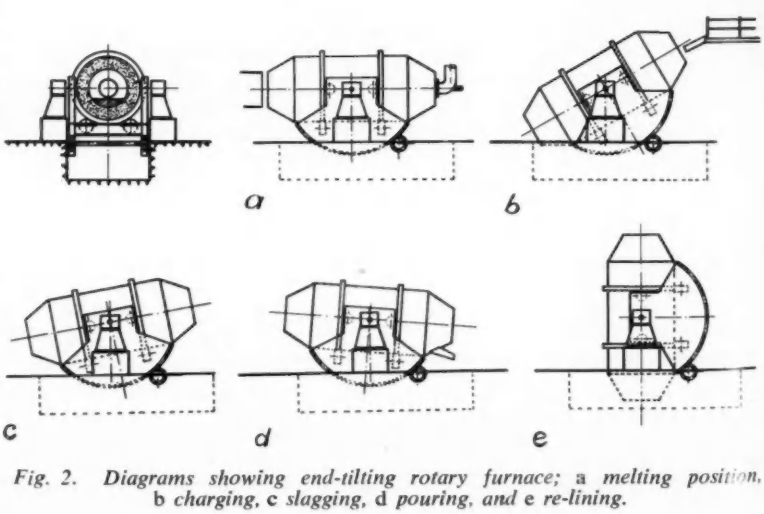
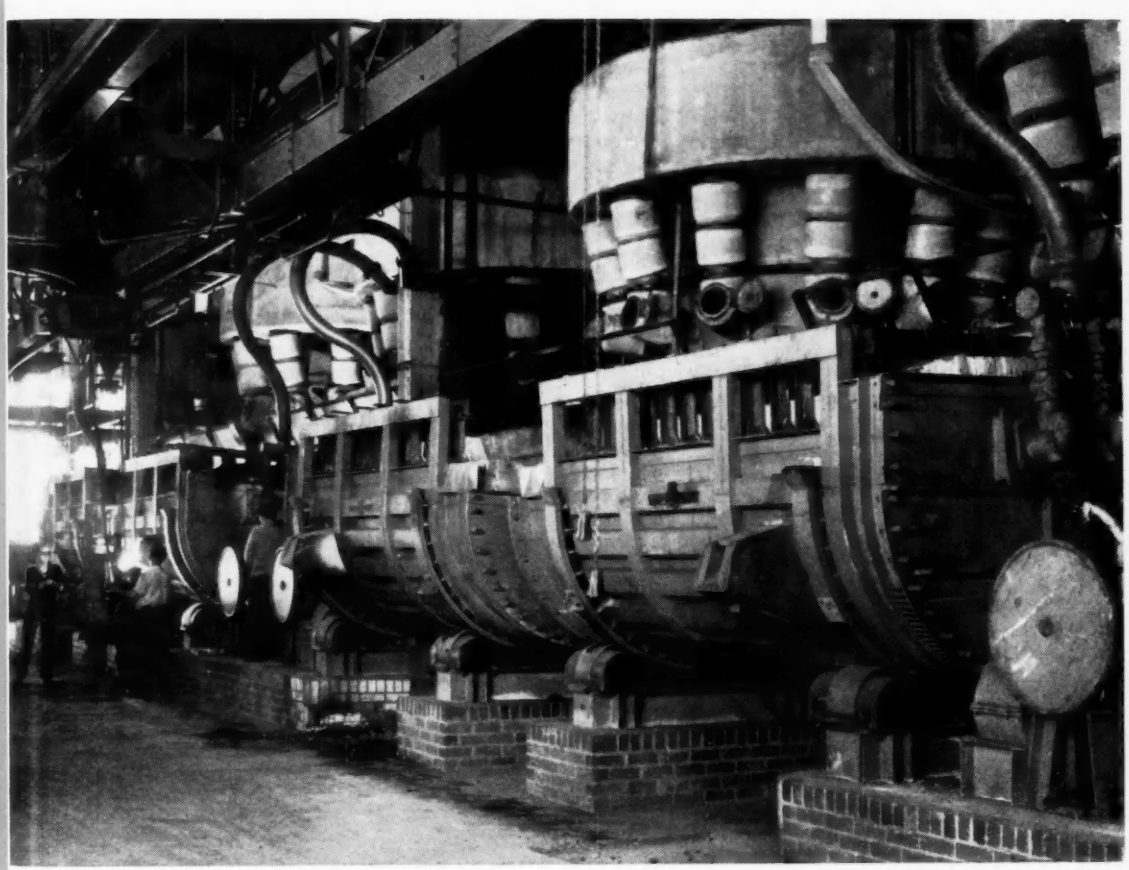


Fig. 2. Diagrams showing end-tilting rotary furnace; a *melting position,* b *charging,* c *slagging,* d *pouring, and* e *re-lining.*

finish of pour will be noted. If the body is tilted vertically as at 'e' relining can be effected either by ramming or bricking without the necessity for taking off the body for this periodical maintenance operation.

The advantages named for the end-tilting type are purely mechanical, there being no difference in the melting efficiency of the two types, either of which are particularly suitable for such large-scale duties as the melting and refining of copper, and for melting malleable and high-duty irons. They are also employed for the reduction of lead residues and battery plates, melting of ceramic frits, melting and holding aluminium, the recovery of aluminium swarf, and so on. The main advantages may be summarised as: (1) Ease of loading; (2) relining if the shell can be effected without removing it from position; and (3) disposal of slag. Fuel costs, by reason of the principle employed, are claimed to be much lower than the results obtainable from any other type of comparable output. Gas (using air-blast burners) is undoubtedly the most convenient fuel for either of the types of rotary furnace referred to, producer gas (120 B.t.u.), town gas (450-500 B.t.u.), or natural gas (1,000 B.t.u. per cu.ft. or over) giving excellent results. As far as comparisons with other fuels are concerned, it has been found that consumption corresponds closely with that of the alternative liquid fuels when reckoned in therms.



Gas-fired hot metal receivers at Ford's

FOUR Monometer gas-fired hot metal receivers installed at the new Thames foundry of the Ford Motor Company at Dagenham, Essex, hold molten iron at pouring temperatures as tapped from the cupola, for maintaining a continuous supply of hot metal to the conveyor system in the foundry.

Each receiver is refractory lined and equipped with a suspended roof in four sections. Two gas burners are located at one end of the receiver and at the opposite end is a hopper to receive the metal flowing from the cupolas. A continuous through-pour of metal is maintained when the receiver is tilted to fill a ladle.

Pouring temperatures

The receivers maintain the metal at pouring temperatures during meal breaks and other interruptions of operation.

In operation the usual method is for the receiver to be heated at the start of the day's work to a temperature about 50° above that of the metal being poured from the cupola.

The receiver is entirely self-contained and the reduction gearing for the tilt embodies a clutch which enables a handwheel to be brought into operation in the event of any current failure. The receivers installed at the Ford Motor Company are for use with coke-oven gas firing or they may be fired by town gas.

CONTROLLED ATMOSPHERE DERIVED FROM TOWN GAS FOR THE HEAT TREATMENT OF METALS

By F. G. ETHELSTON, *Manager, Heat Treatment Division, Birlec, Ltd.*

THE techniques employing gaseous atmosphere for heat treating, sintering and brazing metals and alloys without damaging their surfaces by oxidising, decarburising, carburising or discolouring during heating and cooling are well established and widely used, as are the techniques for surface hardening steel by gas carburising and carbo-nitriding.

A large proportion of the atmospheres used in heat treating processes in this country are derived from town gas and these are generally produced either by direct combustion with air in the furnace chamber, or by full or partial combustion in a separate gas generator. Atmospheres produced by both these methods are described in this article and some of their limitations and advantages are considered.

The accompanying tables, which are not meant to be exhaustive, indicate the atmospheres employed for different heat treatment processes on the commonly used metals and alloys and many of these processes and materials will be discussed.

Before describing the atmospheres produced from town gas, it may be as well to quote the range of composition of raw town gas from one source which can occur:

CO_2	2-4%
O_2	.5-1%.
C_nH_m	2-3%
CO	15-20%
H_2	45-55%
CH_4	20-30%
S	18-25 grains per 100 cu.ft.
N_2	remainder

This variation in composition and the presence of relatively large proportions of oxidising gases limit the usefulness of raw town gas as a protective atmosphere, although it is used to lessen scaling in some applications and, with an ammonia addition, for carbo-nitriding (dry cyaniding) non-critical steel components requiring superficial skin hardness.

The type of atmosphere produced by direct combustion of town gas will not be dealt with in detail here, since the ratios of gas to air required to obtain atmospheres neutral to ferrous materials are such as to render heating with such rich mixtures inefficient and impracticable. The use of oxygen in place of air with town gas enables rich mixtures to be used efficiently, it is claimed, because the nitrogen in the air is eliminated.

Ingress of air

The limitation of atmospheres produced by direct combustion is, the ineffectiveness of the volume of gas fed into the furnace chamber upon turndown of the burners in maintaining a positive pressure, thus allowing ingress of air. This difficulty has, however, been overcome for non-ferrous metals by the injection of water into the furnace to produce steam.

Some protection against oxidation can be gained by employing proportioning devices on the burners. Copper may be bright annealed in a direct-fired furnace, providing the atmosphere in the furnace is kept slightly reducing but with the sulphur present in the form of sulphur-dioxide—not as hydrogen sulphide, which stains copper.

Desulphurised town gas has been burnt successfully in direct-fired batch furnaces having automatic proportioning control on the burners for annealing nickel, nickel coppers and even nickel-chromium alloys which were subsequently cleaned of light scale by pickling.

Bright annealing applications, such as steels, which require a more precise control of atmosphere composition, demand an atmosphere produced in a separate generator, which may be dried or purified to reduce the content of sulphur or any other constituent.

A wide range of product gas composition can be obtained by the combustion of town gas and air in varying proportions. Complete combustion and combustion with as little as 50% of the air necessary for complete combustion, may be carried out in a simple generator employing a gas mixer, a burner and a suitable combustion chamber, without any additional heat being required. This reaction and the generator used are termed 'exothermic' and the gas produced is commonly called 'exothermic gas.' It is usual practice to include a cooler and a bog ore (iron oxide) sulphur purifier in the circuit to reduce the water vapour content and the sulphur in the product gas, so that there is about 2½% by volume of moisture and 2-4 grains of sulphur per 100 cu.ft. of gas entering the furnace. Fig. 1 is a diagram of an exothermic generator. Exothermic gas of this purity is quite suitable for bright annealing and copper brazing low carbon steels; the range of composition is shown in Fig. 2.

Iron oxide purifier

Removal of sulphur down to 2-3 grains per 100 cu.ft. of gas may be accomplished by passing the burnt gas through an iron oxide purifier when 90% of the sulphur in the raw town gas, present as hydrogen sulphide in the burnt gas, is removed; sulphur dioxide is removed with the condensate upon cooling the burnt gas. Where a sulphur content lower than 2-3 grains per 100 cu.ft. is required a catalytic purifier, in addition to an iron oxide purifier, may be interposed in the line before the generator to remove 75% to 90% of the sulphur present before combustion. The bulk of the remaining sulphur is then removed by a second iron oxide purifier after com-

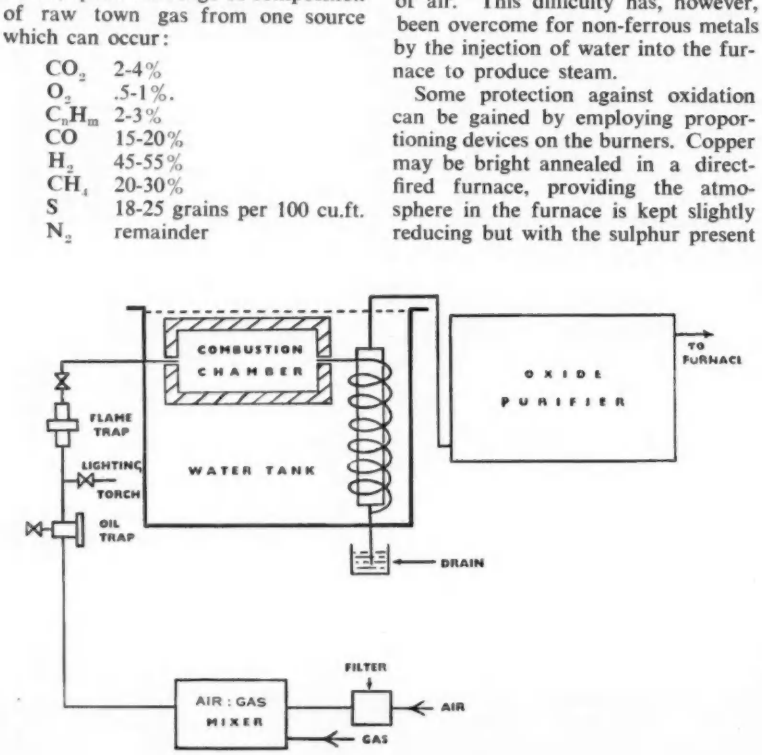


Fig. 1. Diagram of an exothermic generator.

bustion resulting in a product gas containing less than one grain per 100 cu.ft. Exothermic gas of this purity is suitable for bright annealing copper, copper-tin alloys, copper nickels and nickel.

Alternatively, exothermic gas which has been cooled and passed through a bog ore purifier, may be further purified of sulphur by reheating it to 850° C. followed by cooling and passing through a second bog ore box prior to the gas entering a furnace. The sulphur content of the gas may be reduced to .2 grains per 100 cu.ft. in this manner.

Certain types of brasses and bronzes and carbon and alloy steels demand an exothermic atmosphere which has had CO_2 removed and has been dried to a dew-point of −20°C. or lower for bright annealing, and this type of atmosphere is termed 'modified exothermic.'

Removal of the carbon dioxide from exothermic gas may be accomplished by passing the gas through a stripper employing organic solvents such as ethanolamines, and the gas may then be dried by passing it through activated alumina or silica gel. Alternatively, carbon dioxide and moisture as well as hydrogen sulphide may be removed by passing exothermic gas through 'molecular sieves' (sodium and calcium alumina silicates) which absorb the impurities.

Endothermic generator

A product gas low in water vapour and carbon dioxide can be produced by the reaction of town gas with air at richer ratios, that is with 10% to 20% of the air required for complete combustion. This type of gas, a typical composition for which is shown below, is produced in a heated generator embodying a catalyst, since the heat produced by the reaction is not sufficient to maintain reaction temperature. The plant, a diagram of which is shown in Fig. 3, is called an 'endothermic generator' and the product gas 'endothermic gas.'

A typical composition of endothermic gas produced from town gas is shown below:

CO_2	0.2%
O_2	nil
C_nH_m	nil
CO	22%
H_2	48%
CH_4	2%
Water	vapour
N_2	remainder

Carbon potential is defined as the carbon content in steel with which an atmosphere is in equilibrium at the processing temperature. Endothermic gas is reducing and has a high carbon potential which may be controlled by variation of the gas to air ratio. It is, therefore, suitable for protecting medium or high carbon steels during heat treatment without decarburising, or for carbon restoration, or as a carrier gas for carburising low carbon steels when a hydrocarbon gas, *e.g.*, butane, is added in the furnace to increase the carbon potential.

In practice, measurement of the carbon dioxide, present in the gas or of its dew-point is used as an indication of the carbon potential of the endothermic gas. The carbon potential of the gas may also be regulated by altering the ratio of air to gas fed to the endothermic generator automatically by means of a control element associated with the CO_2 or dew-point measuring device.

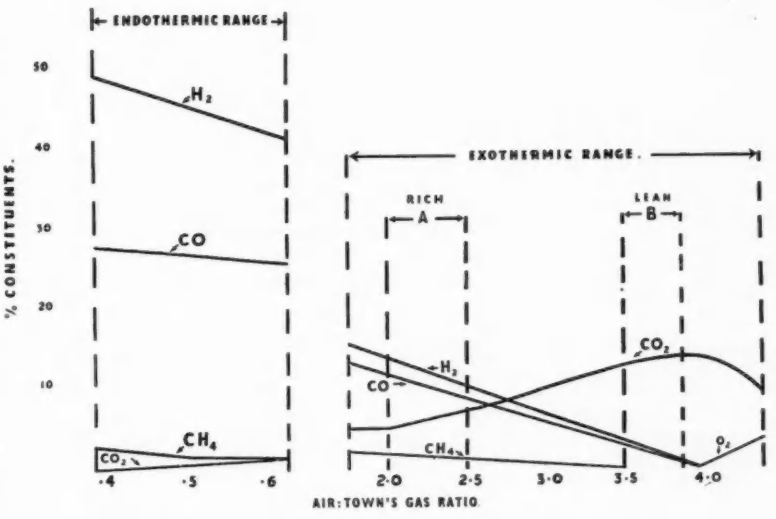


Fig. 2. Range of composition in an exothermic generator.

Endothermic gas contains sulphur derived from the raw town gas used to produce it, and for use with non-ferrous alloys this sulphur can be removed by one of the methods previously described in connection with exothermic gas.

The diagram shows the main constituents present in endothermic gas (Fig. 2).

The tables indicate that a wide range of ferrous and non-ferrous metals and alloys may be bright annealed using town gas-derived atmospheres. Exceptions are stainless steels, stainless irons, and refractory metals such as the numbered 'nimonic' alloys which require a very pure atmosphere free from oxygen-bearing gases, such as hydrogen, cracked ammonia or argon,

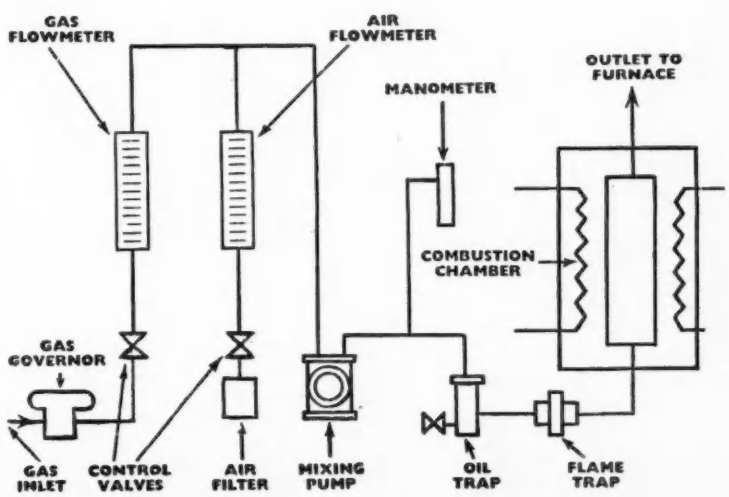


Fig. 3. Diagram of an endothermic generator.

to prevent oxidising on account of their titanium, chromium and aluminium contents.

Tough pitch copper should not be bright annealed in an atmosphere containing preferably greater than 1% carbon monoxide and hydrogen together* and therefore a very lean exothermic gas is required to prevent gassing and consequent embrittlement of the copper. De-oxidised copper can be safely annealed in a lean exothermic atmosphere without consequent embrittlement.

By heating steel work pieces in an atmosphere of endothermic gas and by including an arrangement for transferring them to the quenching medium without exposure to air, they can be hardened without oxidising their surfaces.

Well-established

Gas carburising is well established as an alternative to the older pack carburising method which it is rapidly superseding. Its main advantages over the older method are:

1. Greater uniformity of case.
2. Ease of mechanisation, *e.g.*, for direct quenching from the carburising furnace.
3. Economy of floor space.
4. Cost saving.

Gas carburising is commonly carried out employing an endothermic carrier gas enriched during the carburising period of the cycle with a hydrocarbon gas, *e.g.*, propane or butane. A suitable atmosphere for carburising may also be prepared by passing town gas over hot charcoal, but this lacks the flexibility of the carrier gas plus enrichment system.

An alternative

Carbo-nitriding or dry cyaniding as it has been called, is an alternative to salt-bath cyaniding and is commonly employed for case-hardening steel to depths of up to .030 in. An atmosphere of endothermic carrier gas to which has been added ammonia and a hydrocarbon gas during the carbo-nitriding period is commonly employed. Alternatively, for components which do not require close control of case depth or uniformity, an atmosphere of raw town gas and ammonia may be used.

The advantages of the carbo-nitriding process are:

1. Similar rate of diffusion of case to carburising but at a much lower temperature (800-850°C.) with consequent reduction of distortion.
2. Elimination of period for dropping temperature from carburising to hardening temperature.
3. Increased hardenability induced in steel thus enabling oil quenching to be employed for full hardening the case of carbon steel components otherwise requiring water quenching.
4. Elimination of cleaning operation to remove adherent salt as frequently required when salt bath cyaniding.

A rich exothermic atmosphere is suitable for copper brazing low carbon steels without the use of flux. Medium or high carbon steels would

* W. C. F. Hassenberg and E. C. Mantle, *Metal Industry*, October, 1953.

TABLE 1
BRIGHT HARDENING

Metal processed	Temperature Range °C	Atmospheres commonly used
Medium carbon steels	830—860	Endothermic
High carbon steels	760—800	Endothermic
Alloy steels—medium and high carbon ..	760—860	Endothermic
High speed tool steels	1,250—1,350	Endothermic

TABLE 2
CARBURISING, CARBO-NITRIDING

Metal processed	Temperature range °C	Atmospheres commonly used
All ferrous metals carburising	880—950	Endothermic plus hydrocarbon addition, or prepared town gas.
All ferrous metals carbo-nitriding ..	800—850	Endothermic plus hydrocarbon plus ammonia additions, or raw town gas plus ammonia.

TABLE 3
BRIGHT ANNEALING AND NORMALISING FERROUS METALS

Metal processed	Temperatures Range °C	Atmospheres commonly used
Low carbon steel	600—750 920—970	Exothermic
Medium and high carbon steel (no decarburisation)	600—800	Rich modified exothermic or endothermic
Alloy steels—medium and high carbon (no decarburisation)	650—825	Modified exothermic or endothermic
High speed tool steels (no decarburisation)	780—900	Modified exothermic or endothermic
Electrical silicon steels (stress relief anneal)	780—880	Exothermic

TABLE 4
ANNEALING NON-FERROUS METALS

Metal processed	Temperature range °C	Atmospheres commonly used sulphur free*
Copper (bright anneal)	200—650	Lean exothermic
Brasses (zinc discoloration)	400—750	Lean exothermic or modified exothermic
Bronzes	650—700	Lean exothermic
Monel‡	850—900	Rich exothermic
Aluminium and its alloys	350—400	Lean exothermic (or air)
Nickel, copper nickel alloys (clean annealing)	850—1,000	Lean exothermic
Nickel-chromes (light scale easily removed by pickling)	900—1,000	Lean exothermic

* The amount of sulphur tolerable varies according to the metal processed.
‡ Monel is a registered trade mark.

become decarburised if copper brazed at 1,120°C. in exothermic gas. An endothermic atmosphere is normally employed to avoid this.

Stainless steels, stainless irons and chromium and titanium containing refractory materials will braze only with a pure atmosphere which is dry (dew-point below −40°C.) and cracked ammonia gas, dry hydrogen or argon is normally employed.

For joining copper, brasses and other metals of lower melting point than copper, 60/40 brass and silver solders are used. Exothermic atmospheres may be used. In order to obtain satisfactory joints with these filler metals it is necessary to limit the heating time to avoid loss of the more volatile constituents, and fluxes are usually necessary to obtain satisfactory brazing.

Relatively cheap

From the foregoing it is evident that town gas provides a ready and relatively cheap source of protective or reactive atmosphere, for most of the commonly practised heat treatment processes, after it has been purified or modified to suit the particular application.

Readily available

Petroleum products such as commercial propane and butane which are now readily available in bulk may be used in place of town gas for producing any of the atmospheres mentioned. At present, the economic advantage is in favour of town gas, except in large installations where the capital cost of storage equipment can be amortised in a short time. Two great advantages that petroleum products have over town gas are: Greater consistency of composition and appreciably lower sulphur content; these may well prove the deciding factors in the future in choosing between town gas and propane or butane as a source of process gas, especially where town gas is known to vary considerably in composition. Against these advantages must be weighed the disadvantage of having to provide and maintain storage equipment and having to rely on road transport for delivery.

TABLE 5
COPPER BRAZING

Parent metal	Temperature range °C	Atmospheres commonly used
Low carbon steels	1,120	Rich exothermic
Medium and high carbon steels	1,120	Endothermic
Alloy steels—medium and high carbon	1,120	Endothermic

TABLE 6
SILVER SOLDERING OR LOW TEMPERATURE BRAZING

Parent metal	Temperature range °C	Atmospheres commonly used
Copper or brass (phosphor copper brazing or silver solder)	600—825	Lean exothermic
Cast iron (degraphitised surface) (silver-copper eutectic solder)	900	Rich exothermic

TABLE 7
SINTERING POWDER METAL PRODUCTS

Metal processed	Temperature range °C	Atmospheres commonly used
Iron-copper alloy compacts	1,100—1,120	Endothermic
Iron carbon compacts	1,150—1,300	Endothermic
Bronze compacts	760—850	Endothermic or exothermic
Brass compacts	800—950	Endothermic

Gas-fired kilns help produce glazed art

FOUNDED in 1873, the Carter Tile Works at Hamworthy, Poole, is enjoying a thriving export business, sending original artistic examples of mosaic and faience to Commonwealth countries and elsewhere.

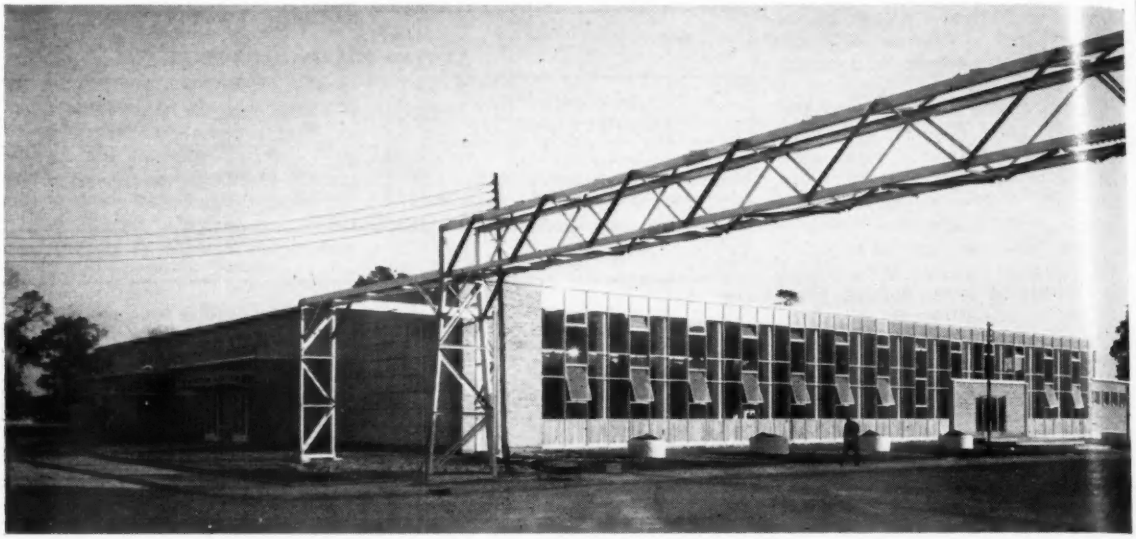
Community centre

For example, an 18 ft. square glazed mural panel incorporating four 10 ft. tall human figures was sent to West Africa and adorns the entrance of a community centre in Accra. Other orders include a crest in the form of a spirited black horse on a white ground modelled for a new Southampton bank building, a 6 ft. 6 in. high coat of arms panel for a New Zealand civic hall, faience and mosaic work for swimming pools aboard the Queen Mary, the Queen Elizabeth and other liners, another coat of arms in heraldic colours for a Trinidad insurance company, 11 1½-cwt., 3 ft. 6 in. high shields for a police memorial at Kuala Lumpur.

In the mosaic department, 12 girls work on patterns made up of multi-coloured tiles so tiny that 2,300 cover a sq. yd. Hundreds of yards are produced weekly at the pottery. Mosaics designed at Carter's are used for walls, floors, shop-fronts and interiors, hotels, inn signs, post offices and so on. The tiles can be wrapped round columns and folded into shapes.

Six kilns

The gas-fired kilns are fired to a maximum temperature of 1,080° centigrade, firing taking 3½ days and cooling 3 days. The clay shrinks ¾ in. per ft. in firing so this must be allowed for by the skilled men who draw the plans. There are six kilns, all using gas. Their A.P. Works has a faience kiln for intermittent use (3,000 cu.ft. per hour). The continuous Williamson tunnel kiln (9,000 cu.ft. per hour) is used in the production of floor tiles. Carter's White Works has a Bricesco continuous tunnel kiln (6,800 cu.ft. per hour) for producing biscuit ware wall tiles, and also three Oressler tunnel kilns (4,500 cu.ft. per hour) each, producing gloss ware wall tiles continuously. Total annual consumption of Carter & Co., Ltd., is 1,180,000 therms per annum, including gas used for ancillary processes, canteen, etc.



Pressed Steel Company chooses gas for canteen at new Swindon works

FORMERLY almost entirely dependent on the railway works, Swindon is rapidly developing as a town remarkable for the variety of its industries. Coincidental with a population increase of 10,000 in the last three years—the total is now 80,000—has come an expanding trading estate and a number of other factories of various kinds. Prominent among the latter is the Pressed Steel Company's expanding works which is producing car bodies for all the major corporations.

To meet the growing requirements of the employees, the Company has just completed an admirable canteen of considerable architectural interest, equipped almost exclusively with gas-operated large-scale catering appliances. The Falkirk Iron Company was responsible for the supply of the equipment and its installation.

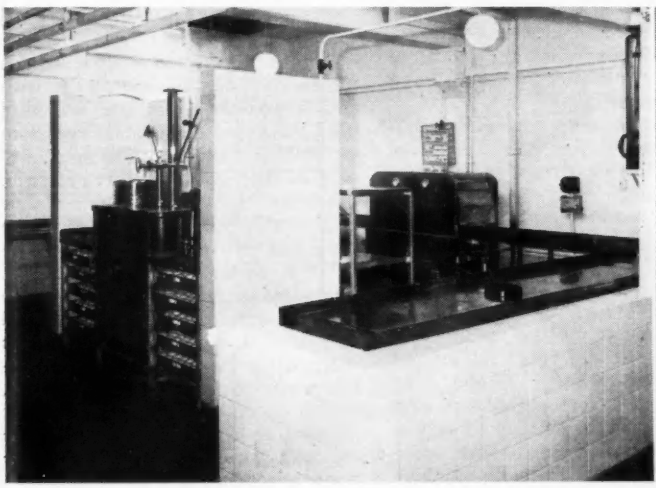
ALL PHOTOGRAPHS TAKEN BY OUR STAFF PHOTOGRAPHER

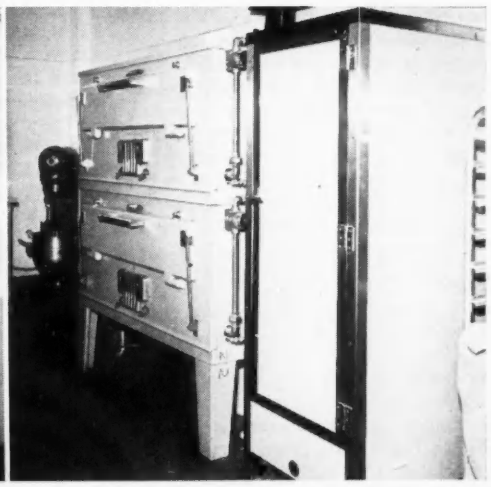
The canteen consists of two main dining halls with a total capacity of 660. In addition there is a junior staff dining room holding 96, an executives' dining room holding 36 and a directors' dining room holding 12. At the moment the canteen is providing 300 main meals a day but this number will be gradually stepped up as the works comes fully into commission; in addition snacks are available to nightshift workers.

Gas appliances include four solid top ranges, a four-deck pastry oven and prover, two roasting ovens, two steaming ovens, two four-pan and one ordinary fish fryers, one stockpot stand, one 6 ft. boiling table, seven 6 ft. hot-cupboards, two grillers, vegetable boilers, two Still café sets, three Still boilers, and a Hobart dish washer.

Gas to a maximum demand of 4,000 cu.ft. per hour is supplied to the new canteen by the South Western Gas Board.

KEY TO THE PHOTOGRAPHS
Opposite page (top): *Exterior of the modern canteen building.* **Below (left):** *Roasting ovens with griller and steaming ovens in background.* **Below (right):** *Serving counter in one of two main dining halls, showing café set.*
Above: *Boiling table, vegetable boilers and stockpot stand.* **Below (left):** *A glimpse of the wash-up with the Hobart dish washer.* **Below (right):** *Part of the bakery showing the four-deck pastry oven and prover.*





GAS FOR FIBRE FACTORY IN COLERAINE

THE Coleraine Borough Council Gas Department has entered into a contract for the supply of gas to the new Acrilan acrylic fibre factory of Chemstrand Ltd., which is now nearing completion in the town. The plant, which will have an annual production capacity of 10 mill. lb. of Acrilan, a synthetic fibre which is already widely used by the British textile industry, is the first of its kind in Northern Ireland. Until now, Acrilan has come from the Decatur, Alabama, factory of the Chemstrand Corporation, U.S.A., of which Chemstrand, Ltd., is a British production and sales subsidiary.

Gas will be used principally in a plant which is being installed by W. C. Holmes, of Huddersfield. This plant, which is being installed in duplicate, will run continuously and in one year will consume over 6 mill. cu.ft. of gas. As it is anticipated that the Chemstrand activities will expand, the contract allows this consumption to be increased to 50 mill. cu.ft. in one year. Gas is also being used in the kitchen and in the factory's laboratories.

The cost of gas to Chemstrand, Ltd., is on a block system varying from 11s. 8d. to 6s. 8d. per thousand cu.ft. with a 5% discount. The firm is also entitled to a rebate on the gas used from the N.I. Ministry of Commerce under the Aids to Industry Act and it is expected that this would amount to 10d. per thousand cu.ft.

The laboratory's function in industrial gas practice

Discussion of a paper by C. P. Henshilwood and R. H. Wharton, an abstract of which was published in December's 'GAS IN INDUSTRY'

Mr. R. F. Hayman, Industrial Gas Officer, Gas Council, said: 'Is there not an illusion abroad that the industrial load goes on growing anyway, that combustion does not matter to the industrial gas engineer and that, therefore, there seems little point in all the effort of testing and development put in by the authors?

'In case they have not quite succeeded in their task of dispelling this illusion, let me try to help them. It is true that in the last seven years sales of gas to industry have risen by one-third of the total, but in that time the number of industrial consumers has fallen. Although the change is in part accounted for by reclassification of consumers between the industrial and commercial loads, it is of the order of 8%.

'The gas industry thrives on being a public service, and its job must be to get new consumers. At least we can say that in the last seven years the number of non-domestic consumers has risen by 6%. There are about 240,000 factories in the country compared with some 93,000 industrial consumers, and even if some plants are at present remote from a source of town gas, there is considerable scope for future load building.

Collaboration

The authors mention collaboration between Watson House and the Industrial Gas Development Committee. For over 25 years this Committee and its predecessors has got on with, among other things, the task of assessing and raising the standards of performance of appliances. Watson House has always been very closely associated with this work, and it will be fitting here to think back for a moment to the man who inspired the output of the first industrial laboratory of the Gas Light & Coke Company, Mr. W. Dieterichs. His memorial for a long time will be the equipment he designed, many examples of which are still in use.

'Let me dispel a further illusion, that the industrial laboratory and Watson House merely make appliances and fittings for the consumer. A great deal of intensive design work has gone on for many years and the results of continuous development work by the staff at Watson House have been incorporated into equipment for consumers. Many appliances have been patented and are now manufactured under licence. Standards of design and layout of controls, of type of materials, and of operating conditions, are now rising steadily due to persistent laboratory investigations and recommendations.

'Let us be clear what we are talking about; let there not be any loose talk about the word "research." Research is the formulation of new ideas as a result of an accumulation of facts. The acquisition of fundamental knowledge is sometimes not of immediate practical application and the authors stress their part in development work which could be defined as the formulation of new ideas arising out of a knowledge of practical techniques. There will be another time and place to mention the quality and value of the contribution which the Industrial Laboratory at Watson House makes to fundamental studies.'

The contacts with appliance manufacturers in the industrial field were essentially different from those in the domestic field, said Mr. Hayman. There was no approved list of industrial appliances. There were many thousands of processes to deal with and relatively few standard pieces of equipment. There was one disadvantage in that any jobbing mechanic or scrap iron collector could call himself an appliance maker . . . and often did. Unless such manufacturers went to a laboratory or listened to suggestions for improvements to their appliances, it was difficult to do anything about raising standards. It took a long time to put across the fact, particularly to non-technical people, that a study of the flow of hot gases was one for the specialist.

Non-confidential

Since the inception of the national scheme for the publication of reports, the industrial laboratory and industrial gas engineers had played a big part in producing information to date. Some 700 reports were available for consultation and of these many were non-confidential. The 'non-confidential' report was innovated a few years ago, and now about 75% of all Industrial Gas Development Committee reports published were freely available to the Press and to anyone interested.

The authors had looked a little into the future and had mentioned the value of case histories. It had been shown that loads could be captured for gas from fuels one-half to one-third of the price per therm. 'The reason lies in the overall cost of production. If this figure is lower, per unit of output, with gas than with any other fuel, then gas has more than a chance of getting the load, and this is largely the basis on which industrial gas engineers deal with consumers.'

Frustration

One of the problems about which the authors must have left some frustration was the inordinate length of time taken for an idea or design to get into production. 'This is a criticism of industry as well as ourselves. Three years is often the minimum time before users can be persuaded of the advantage of a new development. The authors mention that the pursuit of fundamental data should be made side by side with straight-forward development work. I cannot stress too strongly the great value of intelligent observation in the ordinary work of testing and in district operating practice, so that the designer can be fed with information and can have more power to his pencil.

'There is considerable scope for observation on such lines, and I would criticise the lack of availability of this information which I suspect could sometimes be obtained with little effort; when it is obtained, it is often buried in obscure records. A way of expressing results of tests, particularly on the district, is to say what a therm of gas will do and with a little thought figures can be produced from records of existing processes. Development work should be followed up with publication of such information because we are in business to sell gas, and any

sensible technical "gimmick" which we can produce makes this task easier.'

In looking at the wide range of activities carried out in the industrial laboratory, said Mr. Hayman, one could see the importance placed on the value of fundamental studies on the subject of drying. This process had suffered, particularly in American literature, from a surfeit of mathematical theory, but there still remained the typical problem, 'how can such and such be dried?'

The work of the Drying Panel of the Industrial Gas Development Committee, with which the authors were associated, would be of considerable value in solving problems which cropped up continuously. The authors did well to stress the need to control drying performance, since drying a material to a figure lower than the equilibrium moisture content was responsible for a complete loss of time and money. In a tannery, for instance, producing 50,000 lb. of leather a week, a consistent over-drying error of 5%, equivalent to 1% of the moisture content of the finished leather, would account for 50 therms.

Mr. A. E. Tyrrell, North Thames Gas Board, said the paper revealed in some measure the complexity of thermal problems in industry, yet its purpose did not require it to even mention the equally complicated and difficult problem of marketing in competitive conditions, never so adverse as those prevailing today, conditions which at present showed no sign of improvement. 'Yet we sell gas to industry in ever-increasing quantities, and from that we draw some satisfaction, though few outside our immediate colleagues have any knowledge of the planning that has made this possible.'

Basic functions

Mr. Tyrrell went on: 'Effective though these plans appear to be they do not to my mind go far enough. The basic functions of management are production, development and marketing; the character of the functions, their chronological sequence, and the closeness with which they can be integrated will depend upon the degree of skill and understanding in co-ordinating them within the organisation.

'The character and sequence of these functions vary from one form of production to another. In unit production the manufacturing cycle begins with the marketing function, the first task of management in this case being to obtain an order. In process and mass production, it may be quite different, but logically it would seem to me that in the long run research and development programmes, and production schedules, must depend on information passed back from the marketing function.

'Factors will arise necessitating changes within a function, or they may create a new status relationship between the functions. Thus we shall see changing techniques to meet new conditons, but in this changing pattern of the organisation we shall always see clearly and strongly defined the unchanging objectives.

'In our industry those objectives are the same whether we make gas or sell it, whether we are research workers or engineers, and we have established direction in our efforts when we are always consciously aware of this fact. It is the first step towards co-ordinated planning.

Competition

'An overall plan for selling gas to industry, indicating within its framework how to preserve a balance of effort—economics will not support all the staff we would like—between consolidation of load on the one hand and expansion on the other, is essential to the effective combating of the kind of competition we shall face for many years to come. We must have long-term plans to indicate the fields in which we have future markets, and particularly those where we are sensitive. It seems but rational to me that if large sums are to be spent on technical research, it is wise to have planned industrial market research also.

'All this suggests the need for strengthening the bonds that at present exist between the functions between research and the market.

'In order to give practical effect to these views, a survey of the clothing industry was carried out recently in London. Much that was recorded in the survey was confirmation of what we already knew. This industry was, in fact, selected because it would be the most simple to illustrate the value of such work, and we now know precisely where we stand in our present business and, with the many changes forecast for the industry, what our prospects are for the future. Even more important, we can now make recommendations about the plant required to meet the future situation.

'While this essential function of market research is missing from our organisation, we should beware of complacency or over-satisfaction with what we have accomplished, excellent though it may be. We may never know how much more we could have had.

'Nevertheless, industrial gas consumptions do continue to rise, at a time when industrial production is declining. In June this year industrial production in Britain was down by 3%, as compared with the same period of last year. In August it was 7% down, and at present, with the decline in world markets continuing, there seems little hope of improvement. Yet the demand for industrial gas in North Thames is higher by nearly 6% for the same period.

'This increase is coming from the mechanical engineering trades (8.6%), vehicles (over 40%), electrical engineering and appliances (3.5%), all heat intensive industries.

'This is particularly satisfactory, for replanning in London is bringing industrial as well as domestic changes, which are bound to result in overall loss. We must get more from what we have, or we shall reach the situation where the best we can hope for is a rise and fall in keeping with the changes in industrial production.

'We are pinning our hopes for the future on campaigns and competitive drives which, with our improving knowledge of the market, should be even more successful than those of the past.'

Referring to specific items in the paper, Mr. Tyrrell pointed out that it said that the industrial representative always consulted the industrial gas engineer when he had a request for industrial heat processing equipment. This was not the case; he consulted him when he needed special equipment or needed his advice in unusual circumstances.

Surprised

Elsewhere in the paper emphasis was laid on the difficulties due to non-co-operation of factory personnel when carrying out tests. This surprised him, for in a fairly long experience during which he had on occasions badly needed co-operation for quite personal reasons, he had found that if he could have justified it he could have had the top brick off the chimney. 'True, some were unco-operative enough to tell me to get it myself.'

Mr. H. W. Grover, North Thames Gas Board, said, speaking for industrial gas engineers, it was apparent that if laboratory assistance was to be of any real help it must be given with the minimum of delay. In the early days it was not always possible to use the Industrial Laboratory, which had a small staff, as in many cases consumers could not wait while their job was on the waiting list. Many instances could be quoted where the industrial engineer had to take the initiative—sometimes with dire results. Reading the various case histories given in the paper stressed the value of the correct research and testing programme before a final design of the

required equipment was passed to the consumer.

The increase in the personnel of the Industrial Laboratory was such that industrial engineers were now able to pass many more problems to the Laboratory knowing that they would get some information in the shortest possible time.

Mr. H. R. Hill, Bratt Colbran, Ltd., said the waste heat recovery example quoted was a 'very pretty piece of work' but it was a pity that the effect of radiation was ignored until after the test was made on the actual installation. 'The effect of radiation, when calculated, more than filled the gap and I suppose that the decision to leave this calculation out of the reckoning until the experimenters found that they had a credit balance, showed a natural and commendable modesty, but to me it suggests some lack of confidence in the laws of nature.'

On banana ripening, Mr. Hill said the example quoted by the authors seemed to him to illustrate a function of the Watson House laboratory, which, over the years, had meant service with a capital S to both the industrial consumer and to the appliance manufacturer. 'And what a romance for the manufacturer of a flame failure device to suddenly find that he is ripening bananas. I think the authors are too modest in their claims. Bananas were, in the years between the wars, ripened at sea and if the cargo was not ripe when Lands End was sighted, the vessel had to steam around for another day or so, at enormous cost to the owner. If, on the other hand, ripening was too rapid, the ship's furniture was sacrificed in order to make the Port of Bristol ahead of time. Messrs. Henshilwood, Wharton and Perl have revolutionised all this at a cost of three Bray jets and a wooden box.'

Tribute

More seriously, Mr. Hill paid tribute to the staff of the Industrial Laboratory in connection with their activities in testing appliances. The Gas Council Industrial Reports were invaluable to the manufacturer, giving him not only information in the data they contained, but also in providing him with authoritative technical sales literature. 'In developing appliances for burning fuel other than gas one finds no comparable organisation.'

Mr. Hill wondered if there was the fullest possible liaison between the Industrial and Domestic Appliance Laboratories at Watson House. Such liaison could lead to very productive thought. An example of this occurred in his own experience during the early days of the manufacture of the Portcullis gas fires. They encountered a very serious problem concerned with the deterioration of a hardened steel component at a high temperature. After several fruitless attempts to find a remedy they consulted Mr. Andrew who suggested referring the matter to the then head of the Industrial Laboratory, Mr. Dieterichs. With characteristic rapidity he suggested a remedy by employing a special refractory in common use on industrial appliances, but completely unfamiliar to the staff in the domestic space heating laboratory.

This gave an entirely satisfactory solution. It also gave rise to a secondary effect in promoting interest in the possible industrial appliance application of the gas fire as a small but very flexible industrial heating unit, and so led by devious ways to the design of the overhead luminous industrial space heater and a heat processing unit.

Common problem

How such inter-laboratory liaison could best be promoted and nourished was a problem with which all large development and research were faced. Liaison at the top was not always effective, as high level executives often had too little time to think about day to day work and tended to read reports and become 'office fast'—a North Country expression. Inter-laboratory staff discussions offered one solution but they consumed much valuable working time. Mr. Hill said he wondered if frequent and regular exchange of the staff between the different laboratories of an organisation, in which the work demanded the the same basic scientific qualifications, would be the answer.

It could happen that the officer in charge of Laboratory A would assert that he demanded a different standard of quality in his personnel from that demanded by the officer in charge of Laboratory B. Both would have to tolerate the inevitable upset on changeover. The net result would be a pooling of ideas and a widening of horizons.

Mr. Hill concluded: 'I was delighted to hear one of the authors say that they were looking into the future. I hope in this survey they do not exclude the possibility of burning other fuels mixed with gas at the burner. I am told that this is already the practice with gas and oil for some processes in the U.S.A.'

Mr. W. Johnson (Past President), South Eastern Gas Board, said the way he always looked at papers like this one was how it affected selling gas. There were two ways of doing this: One was to give gas away, the other to see that every appliance that could possibly use gas was using it.

Mr. L. W. Andrew, Manager, Watson House, said he attached the greatest importance to co-operation between the departments of Watson House. As far as external co-operation was concerned, he was not always certain that once a job had been done they always knew the final result as soon as it took place. It was terribly important from their point of view that after the event they should know exactly what had happened, so that in every case they could know whether their predictions were correct.

Mr. C. H. Purkis, (President), Watson House, referred to the methods which might be used to make the services of the Industrial Laboratory known, particularly to those people who made the equipment. How did they get to know who to ask to get this kind of service?

In the domestic field the problem was comparatively simple because of the necessity for the Seal of Approval; in the field of commercial equipment the problem was a bit more tricky. There was now in existence a list of commercial equipment, and the knowledge of that list and the use of it for purchasing purposes was greatly extending. But they still constantly came across makers of gas heated equipment they had never heard of before, 'and who to our surprise and to our humbling have never heard of us,' and one had to try to convince them that it would be in their interests to obtain the service available.

Information

Mr. Purkis also spoke about the manner in which essential testing information was gathered together or ought to be made available. It was contained in some measure in technical papers, but while they might be digested by people in the laboratory it was probably a lot to think that an appliance maker was going to have that lengthy document and extract the essential parts.

Mr. R. H. Wharton in replying said that he observed a theme running through the discussion, namely, 'co-operation.' He emphasised the need for co-operation at all levels if the objects of the work of the laboratory were to be achieved. This was necessary within the laboratory itself, with other laboratories at Watson House, with district personnel and with other boards through the Industrial Gas Development Committee.

A point mentioned by Mr. Hayman was the inevitable period required for a development project to reach the production stage. Mr. Wharton said

that this had at times given cause for concern. He had come to realise, however, that while delays needed to be kept to a minimum, the fruition of this type of work often necessitated a gestation period which, if curtailed, might lead to dire effects.

An expansion of staff and equipment had now made it possible for the laboratory to handle a larger number of problems at one time and Mr. Grover had indicated that this was of benefit in turn both to the industrial engineers and the consumers. Mr. Livett confirmed this view by referring to items mentioned in the paper under the headings of 'factory survey' and 'drying hoses.'

Preoccupied

It appeared from the comments made by Mr. Tyrrell that he had seldom encountered difficulty in obtaining co-operation from factory personnel whereas this did not appear to be the experience of the authors. Mr. Wharton mentioned that while personnel down to the level of leading hand were usually helpful, the operators themselves were understandably more preoccupied with their production bonus; for instance, half a dozen ingots thoughtlessly loaded into a melting pot could completely spoil an efficiency determination.

The point of view of the appliance manufacturers was presented by Mr. Hill who had concluded by enquiring whether the laboratory had devoted any attention to oil gas burners. Mr. Wharton was able to point out that combination burners were being examined at this present time.

The question raised by Mr. Purkis as to how the Industrial Laboratory made itself known to appliance manufacturers was one to which the authors had no direct reply. When an unsatisfactory appliance is encountered on the district the matter is referred to the laboratory which in turn contacts the manufacturer and invites him to submit a sample for test.

Mr. C. P. Henshilwood said that he was relieved that not only had most speakers expressed agreement with the contents of the paper, but also that Mr. Wharton had dealt with most of the questions that had been asked.

Another theme running through the discussion had been that of the search for, and application of fundamental knowledge. He was in full agreement with those who had stressed both aspects, and in reply to Mr. Purkis, said that selected parts of the body of information built up in the laboratory over the years would soon be made available in the Industrial Gas Engineers' Handbook, which was being compiled by a panel of the Industrial Gas Development Committee. The Industrial Laboratory at Watson House was represented on this panel.

Liaison maintained

Liaison with other laboratories was maintained in that the knowledge and experience gained by this could be applied to the work of the Industrial Laboratory. A particular example of this had been mentioned in the paper, when the advice of the Watson House Cooker Laboratory had been sought in the application of flash-tube ignition to the gas heated Autoclave.

The use of market research had been mentioned by Mr. Tyrell. Mr. Henshilwood thought that surveys of a particular field could well reveal the necessity for investigations that could be carried out by the laboratory; equally, they could show that development of a particular new type of appliance might be profitable.

Radiation

Mr. Hill had said that it was a pity that radiation had been ignored in the waste-heat recovery calculations summarised in the paper. Mr. Henshilwood confessed that he had been responsible for this omission and excused himself by saying that it had not been obvious from the outside that the flue spigot was lined with brickwork with a high face temperature, and that he had not been particularly keen on looking down the hot flue when the salt bath had been up to temperature! This example had, however, shown the value of work on the district after an installation had been carried out according to laboratory recommendations.

Finally, Mr. Henshilwood thanked all the contributors for their support.

Mr. T. J. Basford proposed a vote of thanks to the authors.

Conference discusses cremator operation

A CONFERENCE held by Dowson & Mason Ltd., of Levenshulme, on the operation of their Lawnswood Negas cremator, was attended by representatives of 15 local authorities from within a 50-miles radius of Manchester. The firm intend to hold further such conferences elsewhere in England.

Also present were crematorium operatives and superintendents, and a large number of Dowson & Mason staff and senior workers.

The Managing Director of Dowson & Mason, Mr. Leonard, welcomed delegates who then toured the works where they saw single cremators being made for Kirkcaldy and a double cremator for Solihull.

Mr. R. H. Anderson, Industrial Gas Officer of the North Eastern Gas Board, one of the originators of the Lawnswood type of cremator, was in the chair at the conference.

Measurement of gas stream temperatures in industrial appliances

II—A suction pyrometer for temperatures above 1,100°C

By
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B.Sc.
and
J. R. HARGREAVES
Midland Research Station, Gas Council

GAS stream temperatures are difficult to measure accurately. A discussion of the sources of error, methods of eliminating them and the development of a portable instrument for use up to 1,100°C. have already been reported (GC 33).

This paper describes the development of a water-cooled suction pyrometer suitable for higher temperatures. Some details are also given of the work on a refractory pyrometer, the development of which was eventually discontinued in favour of a more robust instrument.

Maximum temperature

The water-cooled pyrometer is suitable for use in the field and is designed as a high-temperature accessory for use with the portable suction pyrometer equipment already available. The maximum temperature to which the new pyrometer has been calibrated is approximately 1,600°C., but there seems little reason why it cannot be used up to 1,800°C. by extrapolating the calibration curve. The amount of cooling water required under the worst conditions is specified, and methods of obtaining this are given.

To use the instrument, it is only necessary to provide a $\frac{9}{16}$ in. clearance hole leading to the position at which a temperature reading is required, insert the pyrometer and take a single reading with suction applied. The true gas stream temperature corresponding to this reading may then be found from the calibration curve.

It is axiomatic that a thermometer is an instrument that only measures its own temperature. The measurement of the temperature of a gas stream presents special problems because gases are transparent to the passing of radiant energy from one body to another. This exchange of energy may cause a thermometer to measure a temperature very different from that of the stream in which it is placed. In fact, it has been found that errors of some hundreds of degrees centigrade can be indicated by the direct use of a thermocouple under certain conditions. Many methods have been used to minimise or even eliminate the error due to this radiation effect. One example is the suction pyrometer in which a thermocouple is surrounded by a tubular shield through which a sample of the gas stream to be measured is drawn at high velocity. This appreciably reduces the error, but does not eliminate it. A method of eliminating this error that has been developed at the Midlands Research Station of the Gas Council is a heated-hood suction pyrometer that compensates for radiation losses. This method has been used to measure accurately gas stream temperatures up to about 1,600°C., but this true gas-temperature measuring instrument and the necessary ancillary equipment are too complicated and expensive for general use outside the laboratory.

In portable form

However, with this instrument available it was possible to determine by calibration the residual error of a simple suction pyrometer. For this, a test rig was constructed to provide a uniform gas stream so that simultaneous readings could be taken by the accurate instrument and another pyrometer, the temperature of the gas stream being adjustable over a wide range. On the grounds of cheapness, simplicity and robustness, the simple suction pyrometer was constructed entirely of metal and was, therefore, limited to a maximum of about 1,100°C. The pyrometer, together with its ancillary equipment, was packaged into a portable form for use by industrial gas engineers in the field. This was described in *Research Communication GC*33, which was presented in November, 1956, to the 22nd Autumn Research Meeting.

Since then the portable suction pyrometer outfit has been in considerable demand not only by the gas industry and its associated manufacturing concerns, but also by groups interested in fuels other than town gas: for example, measurements have been made in gas streams containing peat and coal dust, oil and tar products and in many ash-laden conditions where blockage of the probe was considered likely. It is interesting that in none of these cases has blockage occurred. This has led to a considerable demand outside the gas industry: for example, the National Industrial Fuel Efficiency Service organisation is using at least one of these pyrometers in every area in the British Isles. Demand has extended to the Continent where the equipment is being used for research purposes in three countries.

Further development

Since the existing instrument was limited to a maximum of about 1,100°C., whereas gas streams are often well above this, the obvious next step was the development of a suction pyrometer covering a higher range. This would either have to be constructed of refractory materials or cooled so that metal could be used.

The existing test rig and the true gas-temperature measuring instrument were already available for calibrations up to 1,600°C. Therefore, it was decided to investigate the problem of construction and calibration of a simple form of water-cooled metal suction pyrometer that could be used with the portable equipment. Preliminary findings were encouraging and further work led to the design of a suitable pyrometer fulfilling these requirements. Although this instrument could be used over a wide temperature range, it is primarily intended for use in the range above 1,100°C., since a

From a paper to the 24th Autumn Research Meeting, Institution of Gas Engineers, November. 18-19, 1958.

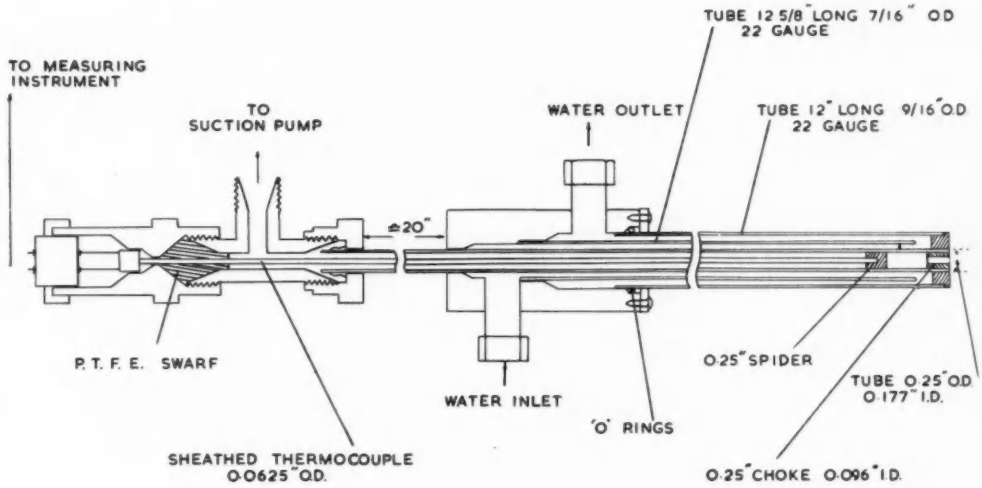


Fig. 1. The final design of the water-cooled metal suction pyrometer.

pyrometer that is smaller, cheaper and does not require water for cooling is already available for use up to this temperature.

As an accessory to the portable equipment, the only addition required apart from the new pyrometer is water at mains pressure or a pump to drive low-pressure water through the pyrometer. If no water supply is available a closed circuit may, of course, be used.

The various stages of work described in this paper are the performance of the calibration test rig at the elevated temperatures, the development of a refractory suction pyrometer, the development and calibration of a water-cooled suction pyrometer and the use of this with the existing portable equipment.

Limited life

The final design of the pyrometer arrived at on this basis shown is in Fig. 1, which also includes the following modifications. It was constructed of stainless steel throughout, the front end of the water-cooled section was welded and the rear was silver-soldered. Previous models, of which six were constructed, had a limited life due to cracking of the front end welds because of differential expansion between the outer and centre tubes. This difficulty was overcome in the final design by the use of a sliding joint incorporating an 'O' ring seal. To reduce gas leaks, P.T.F.E. swarf was used as a packing material at the rear of the tee piece, in preference to the original asbestos packing.

The water-cooled pyrometer was specifically designed for use with the portable equipment already available although, of course, it could be used without this. The equipment consists of two cases, one containing two pyrometers for use up to 1,100°C. and the other the suction line (heat dissipator), compensating cable, indicating instrument, and motor pump unit with a.c. mains lead.

To use the new pyrometer with this outfit, it is only necessary to have a water supply and lengths of tubing with couplings at each end. The cooling water may be:

(*a*) A supply of water at mains pressure, or

(*b*) a supply of water from a tank, using a pump, or

(*c*) a water pump and reservoir for closed-circuit cooling.

The water flow must naturally be sufficient to prevent boiling, in order to avoid damage to the instrument. In addition, since the water-jacket temperature has a slight effect on the indicated temperature, there must be a large enough flow to ensure that no appreciable error arises in this way. The accuracy of the pyrometer is about ±20°C., which is equivalent to an error in indicated temperature of ±12°C., so that an error of, say ±7°C. due to the water-jacket temperature is tolerable. In order not to exceed this, the water-outlet temperature must be restricted to an extent that will depend on the indicated temperature.

The complete outfit enables accurate measurements of gas stream temperatures to be made up to 1,600°C. by using the original metal pyrometer up to 1,100°C. and the new water-cooled pyrometer from 1,100°C. to 1,600°C. Both pyrometers are simple to use and it is relatively easy to install them into positions at which measurements are required. In using the new pyrometer, it is only necessary to provide cooling water by one of the above methods, ensure that the water flow is adequate, provide a hole of $\frac{9}{16}$ in. diameter for inserting the pyrometer to the desired position, measure the indicated temperature with suction applied, and read off the true gas-stream temperature from the calibration curve.

Modest requirements

A compact portable water-cooled metal suction pyrometer has been developed for use as an accessory to the portable suction pyrometer outfit already available. This instrument has been calibrated in the laboratory up to a temperature of approximately 1,600°C. It can be used for measuring gas stream temperatures up to about 1,800°C. Since the pyrometer is a small instrument, the water-cooling requirements are quite modest and can be met in any of three ways. It is robust, accurate, has a high speed of response and can be used as a direct-reading instrument.

There appears to be no reason why it should not prove to be a valuable instrument for field use by industrial gas engineers.

BIRLEC OFFICE MOVE

THE south eastern area office of Birlec Ltd., manufacturers of heat treatment furnaces, dryers and gas plants, has been transferred to Crown House, Aldwych, London, W.C.2 (telephone number: Temple Bar 8040). The south eastern area office of Birlec-Efco (Melting) Ltd., has also been established at the same address.

In addition to providing a sales organisation and service facilities in the Greater London area, the two area offices serve 15 counties.

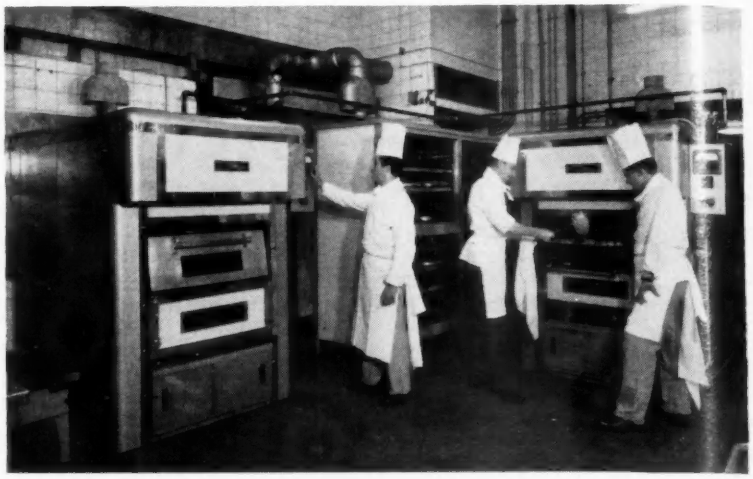
Italian order for Incandescent

THE Incandescent Heat Co., Ltd., have received an order for an annular hearth rotary furnace to be installed in Northern Italy. The furnace will be fired by the Incandescent Equiverse system using natural gas. By this method, oxidation is completely eliminated when heating steel in a direct-fired furnace.

The process can be used with batch or continuous furnaces, for extrusion, rolling, forging, and any other heating process up to 1,320°C. Plants using this system are already in operation in Great Britain, France, Germany, and the U.S.A.

The furnace, which has a mean diameter of 6 metres, will be used for heating alloy steel blanks for piercing in a vertical press, the first operation in the production of high pressure liquefied petroleum gas bottles. High speed fully automatic manipulators, capable of handling up to 42 blanks an hour, are to be supplied with the plant.

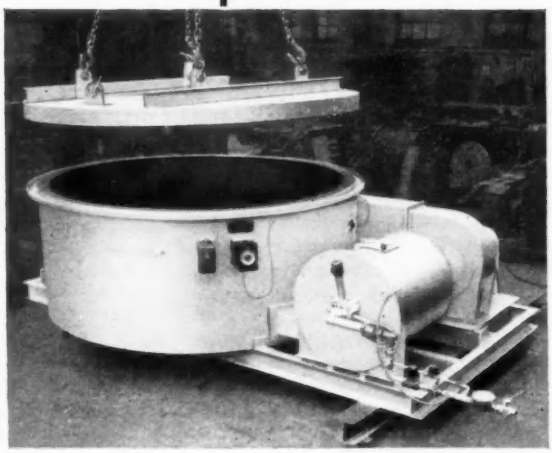
The value of the furnace and its auxiliary equipment will be about £50,000 when installed.



FYNA OVENS FOR THE CONNAUGHT ROOMS

The Connaught Rooms in the North Thames Gas Board's area are renowned for their banqueting and conference facilities. They provide luncheon or dinner service for 26 suites and are equipped to serve up to 6,000 covers a day. Their fine kitchen equipment has recently been supplemented by the installation of two gas-heated Fyna reel ovens, each oven having eight trays. All cooking of poultry, game and meat joints is done in the ovens which are capable of turning out cooked foods on a large scale, at the same time occupying little floor space.

CIRCULAR CONVECTION HEATED TEMPERING OVEN



This has a working chamber 7'6" dia. x 2'6" high and incorporates a recirculation system consisting of external direct gas fired heater and fan. It operates at a temperature of 165°C and is used for tempering gear rings which are loaded horizontally with spacers between. Extremely close temperature uniformity is obtained. A lift-off type cover with sand seal affords ease of handling of charges.

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UGI GROUP

INDUSTRIAL RESTAURANT SERVICE

How can we popularise it, asks 'Gastronome'

THOSE of us who are aware of the value of the gas load taken by industrialists in their works and factory staff restaurants and concern ourselves very closely with the type of equipment used in relation to the particular food service, will have, no doubt, shown no little concern with the decline in the number of customers to this very worthwhile welfare facility. It is a decline that has been moving over the past four years and can be attributed to several causes. In the first place the easing of food rationing made meals at home in the evening of greater attraction and the mid-day meal for many workers consisted of home prepared sandwiches, sufficient to maintain satisfaction until the evening meal.

Monotony and dullness

Another cause is the monotony and dullness of menu that has been so apparent in some industrial restaurants and has turned many customers away to the nearby café or dining rooms. Then there is the restaurant that cooks and serves poor food, so very little can be done in this case except the obvious, and that does not concern us.

Now, how do we in the gas industry interest ourselves in this problem of making the restaurant service more popular? By offering the ideas and equipment that will introduce a supplementary service of such meals, either as a part of the existing service or as a separate self-contained unit or even as the complete alternative to the present set-up. I mean a snack bar service. Reasons?

Many advantages

1. The snack bar offers many advantages to industrial catering and indeed has been introduced by many leading firms with a high degree of success, and may well develop into a trend as the answer, in some measure, to the problem.

2. It displays an appetising array of snack dishes capable of attracting custom.

3. It can provide a full sustaining meal by selection from the menu.

4. It provides a full comprehensive food service from sandwiches to a full meal.

A well organised snack bar service can be operated at a low cost in labour and does not necessarily require as much floor area—both in kitchen and dining room—as the conventional staff restaurant.

All these several points make the situation attractive to management and staff alike and, provided that we in the gas industry are to the fore with our suggestions and have the equipment ready, the catering gas load is maintained. This is really important because it is in the field of snack bar catering that competitive fuel is able to show itself to good advantage. Rest assured that we have the equipment and a very fine array of the various appliances it comprises. What have we and what can it do?

The methods used in snack bar catering are: —Frying — Grilling — Toasting — Heat conserving—Water boiling.

This process will normally be used for the deep frying of chipped potatoes and the equipment suitable may comprise any single pan fryer capable of fast cooking. Particularly suitable is the Oliver Tom's 'Frymaster,' Stott's deep fat unit fryer, Adam's 290 unit fryer, Modern Metals, Ltd., 'Fatmizer,' Main's 91 fryer. (All described in 'GAS IN INDUSTRY' supplement December, 1958.) These fryers will cook 30-60 lb. raw chips per hour according to the appliance and two to three times this amount if the potatoes are blanched or part cooked beforehand.

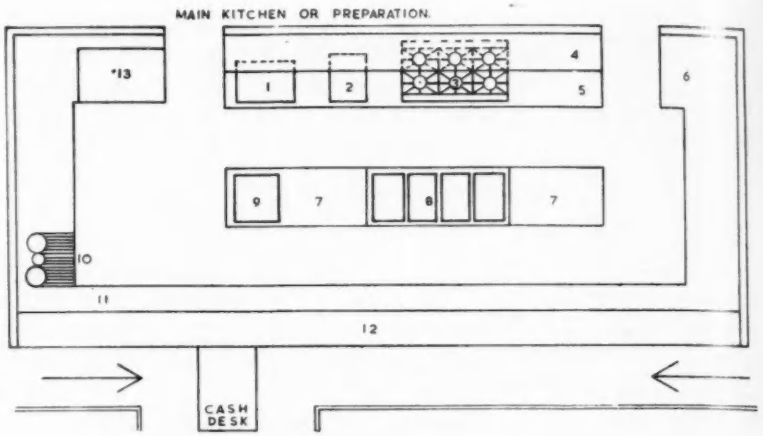
A snack bar service by R. and A. Main Ltd., comprising the 222 grill with grilling hearth, hot cupboard, deep fat fryer and boiling burner top.

First-rate appliances

Dry frying suitable for cooking hamburgers, bacon, eggs, sausages, etc., requires a griddle plate and the Aquafont 'Snackmaster' series griddle, the Benham's 'Fry Top' griddle, and the Adam's griddle are all first-rate appliances for this class of work.

Grills are capable of cooking most foods used in a snack bar service—steaks, chops, bacon, liver, hamburgers, sausages in variety, tomatoes,

and mushrooms, are among the more popular in demand. Gas grills have been developed and produced to a degree in advance of competitive appliances, particularly is this so with grills incorporating bottom cooking plates. These are cast plates with an integral fat trough, usually about ⅜ in. in thickness, upon which the food is placed after preparation and cooked by radiation from the burners above and by the conduction from the plate beneath, which is heated by the 'wasted' radiation from above. It is claimed that food grilled in this way takes half the time and is superior to that cooked in the way previously associated with grills.



LEGEND : 1. Grill with cooking plate. 2. Deep fryer. 3. Multi-ring boiling table. 4. Shelf at 4 ft. 6 in. 5. Bench-fryer inserted. 6. Plating-up bench, salads, etc. 7. Hot-closet-plain top. 8. Hotcloset with fitted bain marie. 9. Double grill for toast, etc. 10. Coffee and milk. 11. Serving counter. 12. Illuminated shelf at 4 ft. 6 in. 13. Refrigerator.

The layout of this snack bar service is operated by two cooks and three servers/cooks. The length of bench is necessary for pre-plating of salads and cold dishes. The divided queue bar to the cash desk reduces crowding and makes for a speedy service.

Appetising snacks

Toast will be required in quantity and it is recommended that a separate grill or toaster be used. This will not only toast the bread but can be used for all those appetising snacks that are served on toast, sardines, eggs, beans, fish roes, cheese and so on. Here are a few of these grills that can be recommended with confidence. The two Main's grills, the 222 and the 225. (The 225 can be installed as a double tiered unit.) The Radiant Heating Ltd., 'Grillmasters,' the Benham and the Radiation Ltd., grills and salamanders.

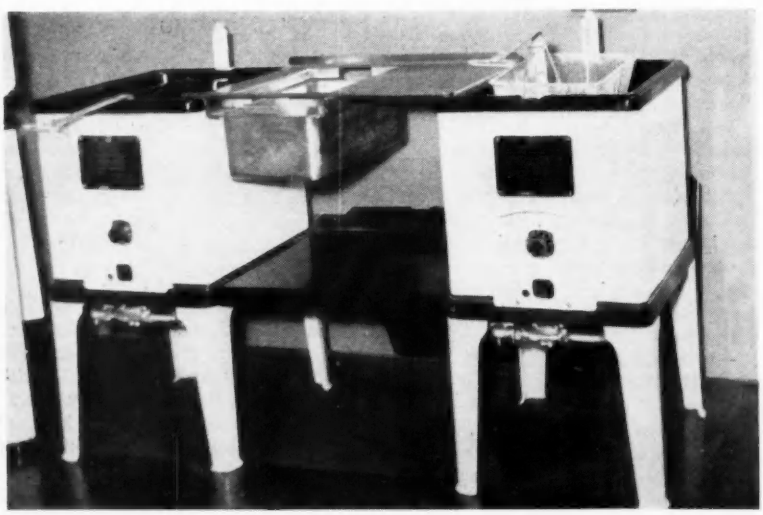
The success of a snack bar service depends largely upon quick service and hot food, it is therefore necessary to cook beforehand all foods that can be kept hot without deterioration in quality. The success of storing hot food is to maintain it at slightly above serving temperature (160°F.—180°F.) but not higher than 180°F., otherwise the cooking process will continue and a loss of original flavour and drying out will occur.

Food is best kept hot in bain marie containers heated by either hot water, steam vapour or hot air. If the hot air method is selected it is essential to thermostatically control the temperature so that the ceiling of 180°F. is not exceeded.

Automatic plate raiser

Such a bain marie suite of containers can best be fitted on top of a hotcupboard which will be required for the accommodation of plates. The introduction into the scheme of an automatic plate raiser, whereby the heated plates are brought one by one to the service top by a spinning action below the stack of plates is strongly recommended.

The provision of boiling water needs to be carefully planned in snack bar work. It should preferably be divorced entirely from the service counter itself and, if floor space permits, a separate kiosk is a good plan. This can be sited away from any queue and indeed helps to keep the bar clear of waiting customers.



The assembly of two R. and A. Main deep fat fryers with fat drainage and holding bin for dipped potatoes.

Coffee in bulk

Equipment is normally needed to cover coffee, milk and fruit drinks. The coffee should be made in bulk and should be stored separately from the heated milk. Conventional café sets of suitable storage are excellent and storage urns as gas hotplates are ideal, capacities varying from one to four gallons on both coffee and milk.

Back to the snack bar, do install a boiling table or series of hotplates upon which omelettes can be cooked, the beans heated, the eggs scrambled and poached and all the various cooking that needs hotplate treatment.

In first

Remember we have the equipment, really first-rate equipment, and if the trend to snack bar service spreads we shall want to be in first.